FRACTURES OF THE HEAD AND NECK OF THE RADIUS

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The frequency of fracture of the proximal end of the radius, as compared with other fractures about the elbow, is approximately 3 per cent. It is, therefore, not a rare fracture; neither is it a common one. There have been 420 fractures about the elbow admitted to the Children's Fracture Clinic at Bellevue Hospital in the past ten years. Of this number only fourteen were of the proximal end of the radius.

This fracture is caused by both direct and indirect violence. In children it is about equally divided, while in adults direct violence is more common.

Diagnosis, as a rule, is quite simple. There is a history of either direct or indirect violence. The physical findings are: A swelling about the elbow, point tenderness over the head of the radius, normal relationship of the epicondyles and olecranon; crepitus is not usually present. The arm is held in partial flexion and semipronation. Motion about the elbow in any direction is painful. This is especially true of rotation. (Usually flexion and extension are not painful except in extreme position.) If the forearm is passively rotated, the head of the radius does not rotate with it. Pain and swelling over the dorsum of the hand frequently occur.

By careful examination one can usually make an accurate diagnosis; but the final and definite diagnosis must depend upon X-ray examination. X-ray pictures taken in two planes will determine the presence of and the particular type of fracture.

For purposes of treatment these fractures may be divided into three groups. *The First Group.*—Includes simple fractures without displacement of the fragments. It is generally agreed that this type of fracture should be treated conservatively. The arm is placed in moderate flexion with the hand in complete supination, in a posterior molded plaster splint, and held in this position for two weeks. This splint should be removed at intervals and active motion instituted, then replaced. At the end of two weeks the splint is permanently removed. The elbow is then baked and massaged. If so treated the results are universally good.

The Second Group.—Includes simple fractures with displacement of fragments, where the orbicular ligament is not badly damaged and where the fracture line does not involve the articular surface. These fractures should be operated at once, the fragment replaced in its normal position and held there by suture of the ligaments and muscles, or by the use of a band of fascia lata. The forearm must then be so placed as to best maintain this position, which can usually be accomplished by moderate flexion and semipronation. With the arm firmly held in this position by an assistant, the

wound is closed and a posterior molded plaster splint applied. The treatment then followed is the same as that given the cases in Group One.

The Third Group.—Is composed largely of the comminuted and badly displaced fractures which cannot be satisfactorily replaced. Resection of the head in these cases is imperative. A chip fracture of the head, which does not rotate in the lesser sigmoid cavity of the ulna, *i.e.,* a small lateral fragment, may be dealt with by simple removal and repairing of the orbicular ligament.

The growth of bone in children, which is usually a great adjunct and which in most fractures may be relied upon to correct deformity, cannot be depended upon to the same degree in fractures of the upper end of the radius. It has been a source of great disappointment to us to find a marked tendency to proliferative periostitis in both operated and non-operated cases, with a resultant synostosis between the radius and ulna. The immediate post-operative results usually are very good; flexion and extension readily return to normal. Rotation, which is a most important function of the elbow-joint, is also satisfactorily restored. In some of these cases the follow-up shows a gradual thickening of the proximal end of the radius, beginning as a productive periostitis, causing a gradual loss of rotation which finally becomes complete and due, of course, to a synostosis of the radius and ulna. This condition is not easily corrected, as was shown by one of our earlier cases in which the callus, together with the involved upper third of the radius, was carefully resected. Full rotation was restored only to be again completely lost by reformation of the resected portion and more callus, causing a recurrence of the synostosis.

In judging end-results in fractures of the head and neck of the radius, there are four major considerations, *viz:* (1) Pain. (2) Stability of the elbow-joint. (3) Function. (4) Anatomical deformity. All, of course, are interrelated, especially pain and stability. Pain is, however, the greatest disability from the patient's point of view. It is usually in direct proportion to instability, so in choosing the type of treatment for a given fracture, these two considerations must receive the greatest attention.

Function.—Since the head of the radius enters into two distinct joints, it naturally contributes to both functions, *viz.:* flexion and extension and supination and pronation of the forearm. Fortunately, in fracture of the head and neck of the radius, flexion and extension are seldom limited. However, it occasionally occurs from excess callus or the formation of a loose body which locks the joint and prevents this function. Rotation, on the contrary, a most useful movement, is where we find most of our loss of function. This is usually due to synostosis of the radius and ulna, in the region of the fracture. It is most difficult to prevent and, indeed, in some cases that have a tendency to prolific callus formation, it is impossible. In order to avoid this disturbance, where open operation is done, extreme care should be exercised to remove all spicules of bone and shreds of periosteum.

The end of the radius should be smoothed off and the orbicular ligament carefully repaired.

In spite of these precautions, synostosis, with complete loss of rotation, occurred in 50 per cent. of the children operated upon for removal of the head of the radius. In none of these cases could a satisfactory replacement be accomplished. It is, however, surprising how this loss of function is compensated by the rotators of the arm and scapular muscles.

Anatomical deformity is, fortunately, not very great in this fracture. An increased carrying angle of the forearm is always found and is practically the only deformity.

In operated cases the prognosis cannot be made from inspection of the histories and operative findings, since very similar cases give opposite results. For instance, "G. Y.," a girl of six, had a minimum of trauma. She fell while roller-skating. She was operated promptly by Bohrer, who used the same technic and same post-operative treatment as in the case of "J. S.," a girl of nine, who also fell while roller-skating. The X-ray pictures were quite comparable in the two cases, yet in "G. Y." the radius and ulna became synostosed and she lost her rotation, while "J. S." resulted in normal restoration of function.

This is also true in cases operated by Beekman. "W. D.," a boy aged ten years, operated seven days after the accident, resulted in normal restoration of function; while "R. M.," a boy of ten, operated ten days after the accident, resulted in synostosis of the radius and ulna.

From observation of these reported cases over a prolonged period of time and a review of the literature, I have come to the following conclusions:

(1) Fracture of the head and neck of the radius, in children, should be treated conservatively unless there is marked displacement of the fragment.

(2) In cases of marked displacement of the fragment, early operation with replacement of the fragment is preferable to resection.

(3) If resection is done, about 50 per cent. will develop synostosis of the radius and ulna in the resected area. This synostosis occurs several months after operation.

(4) In resected cases a stable, non-painful joint may be expected.

(5) Flexion and extension are seldom limited.

(6) In resected cases an increased carrying angle always develops, apparently from a lack of growth at the proximal end of the radius.

(7) In adults: Simple fracture with displacement, even if the fracture line involves the articular surface, should be treated conservatively.

(8) In operative cases resection of the entire head of the radius is the operation of choice. A stable, non-painful joint, without loss of function, may usually be expected.

SUMMARY AND ANALYSIS OF CASES

(1) Of twenty cases which form the basis of this report, twelve were treated conservatively. Those with slight displacement have excellent results.

Those with marked displacement have loss of rotation and some loss of flexion and extension.

(2) Of the children's cases, five were operated for resection of the head of the radius. Two recovered full function permanently; three had complete function when discharged from the hospital, but over a period of several months, rotation was lost from productive periostitis followed by synostosis of the radius and ulna.

(3) Of the children's cases nine were treated conservatively. Three of these had severe injuries with displacement or comminution of the head of the radius; two became synostosed with loss of rotation; one recovered complete function. The remaining six, with slight trauma, recovered complete function.

(4) One adult case, operated for resection of the head of the radius, resulted in complete restoration of function. Another adult case, where replacement of the fragment was done, resulted in loss of rotation and 20 per cent. loss of flexion and extension.

(5) Of the adult cases, four were treated conservatively. Three recovered complete function; while the fourth, whose fracture involved the joint surface, has limited motion in all directions.

LITERATURE.—There is considerable difference of opinion among authors on the advisability of treating this fracture operatively or conservatively.

Culp[3] reports four cases, all adults, in which the fractured head of the radius was removed. There was complete restoration of function, with minimum loss of time.

The conclusions of Key's[8] excellent paper are: "Certain fractures of the upper end of the radius should be treated conservatively, others should be treated by immediate operation with either removal or replacement of the head, and others should be treated expectantly and the head removed later if necessary. In children, the displaced head of the radius can be replaced by open operation and a practically normal elbow and forearm may be expected.

"After early removal of the head of the radius, a satisfactory but not a normal elbow and forearm may be expected.

"Traumatic arthritis is the result of function in a disorganized joint, and late removal of the head of the radius after the arthritis has developed will not as a rule cure the arthritis."

E. Lassen,[4] of Copenhagen, believes in conservatism. He reported seventy-one cases. Sixty-three were treated conservatively. Subsequent examinations were done in fifty-seven cases, including the eight operative cases. Thirty-one of the fifty-seven were good functional results; moderately good in fourteen, and poor in four. (The operative cases did not give good results.) Open operation was used only in grave fractures and, with but a single exception, was performed at a late date.

Pfab[5] reports fifty cases. Direct violence in twenty-nine; indirect violence in twenty-one. Only in those cases where the injury was less severe did he get a perfect result.

He resected eight cases, in three of which there was complete restoration of function.

Philips and Gallard[6] report five cases of fracture of the neck of the radius, in which the Röntgen-ray examination revealed: "A fracture involving the posterolateral corner of the proximal juxta epiphyseal portion of the diaphysis of the right radius, the fracture entering the epiphyseal line, thus chipping off a pyramidal piece of bone measuring about one-half inch on a side." Apposition of the fragments was perfect except in one case.

All were treated conservatively with the arm held in Jones' position. Each case resulted in complete recovery of function.

Bohler[7] states: "If the head of the radius is fissured in its long axis, or is broken off without any displacement, it is treated by the application of a plaster bandage which is left on for four weeks, and in the same manner as the fractures of the olecranon. If the head is splintered and the fragments are displaced, or when the head is broken and dislocated, it is very seldom possible to obtain a good position. The rotations of the forearm are either quite limited or disappear altogether. In these cases, it is therefore best to remove the head. The incision is made on the lateral side but should not reach too far anteriorly, because small branches of the radial nerve are apt to be injured. A plaster case is given for two weeks."

Scudder[9] states that in fractures of the head and neck of the radius, in children: "The elbow should be placed in the acutely flexed position with forearm in complete supination after manipulative pressure and traction on forearm. Usually after ten days guarded painless motion may be begun and along with massage will succeed in securing almost perfect function of the joint."

In adults: "Excepting in linear fractures without much if any displacement, a complete removal of the head of the radius immediately after the injury should be done. All fragments should be carefully removed. Avoid injury to the joint capsule and synovial membrane. Keep the annular ligament intact. Close the wound tight. In about a week or less begin active guarded movements.

"In operating, the fragments of bone should be removed, and when the exact conditions are seen a complete resection of the head of the radius done. Operation is indicated with a complicating irreducible dislocation of radius or ulna or both.

"Gentle massage and passive motion and attempts at active motion should, within four to eight weeks, result in approximately normal elbow movements."

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